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Montana. State Water Projects Bureau
Ackley Lake Dam

# ACKLEY LAKE DAM

## Manual for Operation and Maintenance

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# OVERVIEW

Ackley Lake Dam is located in Judith Basin County approximately 4 miles southwest of the town of Hobson (Figure 1). This offstream reservoir is fed by a supply canal from the Judith River. Runoff is also collected from a natural drainage area of 2.6 square miles above the project. The Ackley Lake Water Users Association (herein called "association") operates the dam.

The earthfill dam was completed in 1938. The dam has a hydraulic height of 51 feet and a structural height of 55 feet. The crest width is 25 feet (including riprap), and the length is 3,514 feet. The dam's outlet works consist of an 8-gauge corrugated metal pipe that is 390 feet long and 48 inches in diameter. The pipe, which has a bituminous coating, is galvanized, close riveted, and soldered with watertight band couplers. The headgate is a 48-inch diameter slidegate valve which is manually operated. Controls for the gate are located at the top of the tower. The spillway, an unregulated trapezoidal earthen structure, is located on the left (northwest) side of the dam. The spillway width varies from 17 to 20 feet.

Water from the reservoir is primarily used for irrigation water supply. The reservoir also is used for fishing and other water-based recreation.

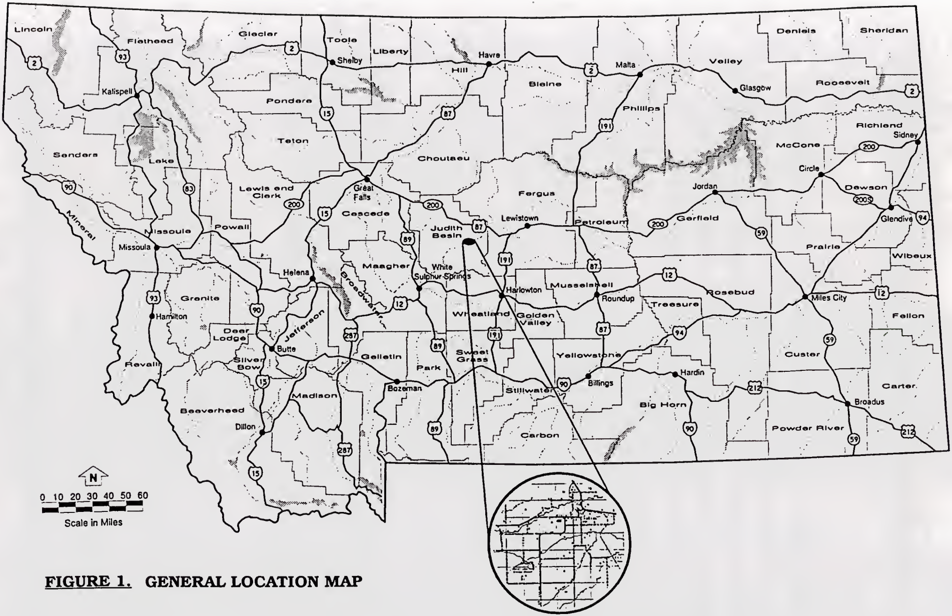


**FIGURE 1.** GENERAL LOCATION MAP

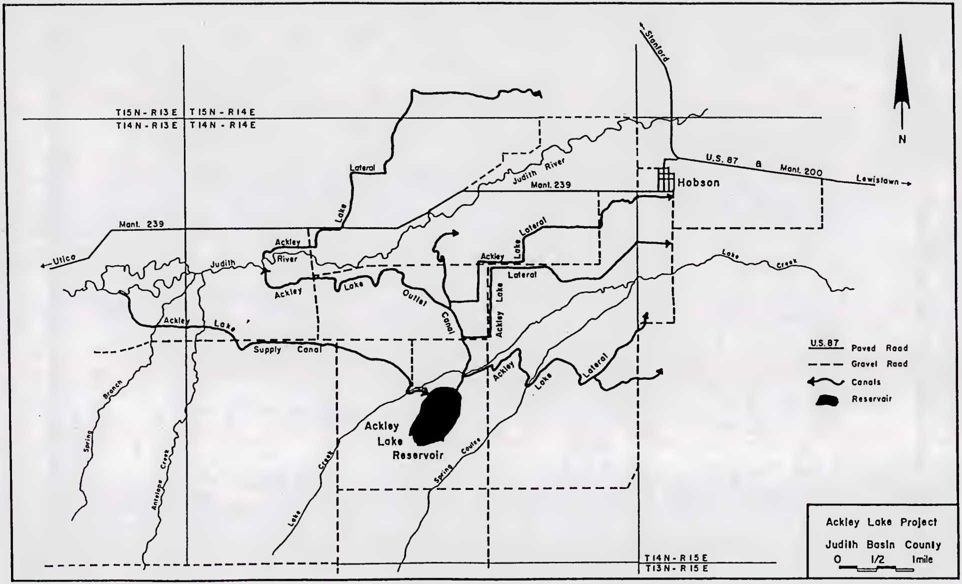


**FIGURE 2.** PROJECT AREA MAP

## STATISTICAL INFORMATION

### 1. *General*

| | | |
|---|---|---|
| a) | Owner | Montana Department of Natural Resources and Conservation (DNRC) |
| b) | Operator | Ackley Lake Water Users Association |
| c) | Location | Section 22, Township 14 North, Range 14 East, Montana Principal Meridian; 4 miles southwest of Hobson |
| d) | Latitude<br>Longitude | 46° 57' 30"<br>109° 55' 54" |
| e) | County--State | Judith Basin--Montana |
| f) | Watershed Location | Offstream of the Judith River. Main watershed intercepted by the supply canal is Antelope Creek. |
| g) | Drainage Area | 2.6 square miles |

### 2. *Principal Elevations* (feet above mean sea level)

| | | |
|---|---|---|
| a) | Minimum Dam Crest | 4,323.7 feet |
| b) | Normal Full Pool | 4,316.3 feet |

### 3. *Reservoir*

| | | |
|---|---|---|
| a) | Length of Maximum Pool (approximate) | 0.78 miles |
| b) | Maximum Reservoir Storage of Record | 6,165 acre-feet (5/30/89) |
| c) | Surface Area at Normal Pool | 260 acres |

### 4. *Storage*

| | | |
|---|---|---|
| a) | Maximum Storage (elevation 4,323.7 feet) | 8,315 acre-feet |
| b) | Active Storage (elevation 4,315.67 feet) | 5,815 acre-feet |
| c) | Maximum Surcharge (elevation 4,323.7 feet) | 2,500 acre-feet |
| d) | Dead Storage | 325 acre-feet |

### 5. *Hydrology*

| | |
|---|---|
| Inflow Design Flood | 1/2 Probable Maximum (1/2 Flood PMF) (6,615 cubic feet per second (cfs) peak flow) |

### 6. *Embankment*

| | | |
|---|---|---|
| a) | Type | Earthfill |
| b) | Hydraulic Height | 51 feet |
| c) | Crest Length | 3,514 feet |
| d) | Crest Width | 25 feet |
| e) | Upstream Slope | 1v on 2h |
| f) | Downstream Slope | 1v on 2h |

### 7. *Outlet Works*

| | | |
|---|---|---|
| a) | Size | 4-foot diameter corrugated 8-gauge metal pipe, galvanized, close riveted, soldered with watertight band couplers, with a bituminous coating. |

|  |  |  |
|---|---|---|
| b) | Length | 390 feet |
| c) | Control | 48-inch diameter slidegate valve, manually controlled. |
| d) | Capacity: | 250 cfs to existing spillway crest (elevation 4,316.3)<br>275 cfs to first overtopping dam crest (elevation 4,323.7) |
| e) | Design Invert Elevation | 4,278 feet |
| f) | Trashrack | Yes |

## 8. *Spillway*

|  |  |  |
|---|---|---|
| a) | Location | Left abutment |
| b) | Crest Elevation | 4,316.3 feet |
| c) | Design Crest Elevation | 4,315.67 feet |
| d) | Type | Unregulated, trapezoidal earthen section |
| e) | Crest Width | 17 to 20 feet |
| f) | Capacity (to elevation | 1,410 cfs |

## OPERATING PROCEDURES

The association operates Ackley Lake Dam and reservoir to provide an adequate supply of irrigation water to meet contracts with the water users without exceeding safe storage or flow levels.

### Method And Schedule Of Operation

The inlet canal gates are opened whenever the spring thaw begins. This can be as early as the first part of March or as late as May, depending on the individual year. A local mail delivery employee who regularly crosses a Judith River bridge on the mail route and a water user who lives close to the Judith River act as "spotters" for the dam operator. Whenever the first signs of spring thaw occur, the "spotters" contact the dam operator, and the canal gates are opened.

The association's goal is to have the reservoir full before contract holders start putting in calls for water. The date irrigation releases begin varies from year to year, with May 1 typically being the earliest. Irrigation releases usually end by October 30. The actual irrigation season depends on each year's climatological and hydrological conditions.

The maximum reservoir elevation for winter storage is 4,305.68 feet with 3,555 acre-feet of storage. This winter maximum helps prevent damage to the riprap and embankment from wind-driven waves and ice. The minimum reservoir elevation for winter storage is 4,284 feet with 458 acre-feet of storage. This winter minimum helps prevent ice damage to the inlet structure for the outlet works.

**Safe Drawdown**

Because the stability of Ackley Lake Dam has not been thoroughly investigated, the DNRC recommends that drawdown rates not exceed one foot per day.

**Limitations Of Appurtenances**

Appurtenances at Ackley Lake Dam include the supply canal, outlet and lateral canals, spillway, and outlet works. The supply canal's design capacity is 200 cfs, with a bankfull capacity of 350 cfs. At the minimum dam crest elevation, the outlet works' capacity is 275 cfs. The spillway has a capacity of 1,410 cfs at the minimum dam crest elevation. The maximum capacity of the delivery canal is 48 cfs. If the outlet works are operated far in excess of the delivery canal's capacity, the canals and structures can be damaged.

The spillway rating table is shown in Appendix A, on Table A-4.

The maximum gate opening for the low level outlet gate is 4 feet. Openings in excess of this amount may damage the gate, gate frame, gate stem or the gate operating pedestal. The 4 feet of operation is measured on the exposed portion of the gate stem between the top of the pedestal and the bottom of the stop nut.

**Dam Operator**

The responsibility for the daily operation of the dam and reservoir rests with the association and its dam operator. The dam operator is generally authorized to operate the reservoir to meet the association's goal of providing adequate irrigation water to meet existing contracts while maintaining safe storage and flow levels. The dam operator's specific responsibilities are to:

1. *Operate the mechanical features of the outlet works.*
2. *Coordinate filling the reservoir and releasing the water.*
3. *Notify the State Water Projects Bureau (SWPB) of unusual occurrences such as impending floods or excessive seepage.*
4. *Perform various maintenance tasks.*
5. *Maintain water level records, and report the findings to the SWPB.* Normally, water level measurements are taken monthly during the irrigation season. A continuous recorder is also maintained on the supply canal by the dam tender. Readings are typically reported to the SWPB the first of each month during the irrigation season.
6. *Monitor weather conditions.*
7. *Monitor seepage.*

The out-going dam operator, association, and the SWPB will train a new dam operator. The dam operator's training focuses on the mechanical operation of the gate, measurement of the storage level, measurement of the rate of water release, and record keeping. The outlet gate is operated manually with a hand wheel. The outlet works are intended to be used for controlling the release of irrigation water, and not for providing emergency relief. If the outlet works are operated for emergency relief beyond the outlet canal's capacity, the canal and structures below the dam would be damaged.

The dam operator is normally available daily to observe the dam and perform operating functions during the filling and irrigation seasons, and is available several times per week at other times of the year. Communication among the dam operator, the association, and the SWPB usually takes place by telephone. Although not routinely available, radio communication may be established during emergencies or unusual occurrences so the dam operator can speak directly with county authorities and communicate indirectly with the SWPB (see *Ackley Lake Dam Emergency Plan*).

### Weather Monitoring

The dam operator monitors weather conditions through local weather forecasts and the National Weather Service.

### Interaction With Other Dams

Except for Fort Peck Dam, the only dams located downstream of Ackley Lake Dam are irrigation diversion dams. The safety of these irrigation diversion dams are not affected by the operation of Ackley Lake Dam during either normal or emergency operations. Therefore, interaction with other dams is not a concern during the operation of Ackley Lake Dam. If it appears that the Ackley Lake Dam will breach, the dam operator should notify the operator at Fort Peck Dam (**406-526-3411**).

## INSPECTION AND MONITORING

The SWPB will inspect the dam annually. Appendix B includes an example of a SWPB inspection checklist. In addition to annual inspections, SWPB personnel will inspect the dam and reservoir during and after heavy runoff, severe rainstorms, and severe windstorms; during high storage periods; and after an earthquake. The embankment is not monitored by instrumentation.

### Structural Features Inspection

Structural features include the gatehouse, spillway, and outlet works (Figure 3). The SWPB will inspect these structures annually as part of its inspection program. Items checked or noted include, but are not limited to:

1. *Outlet Works*
    a) Any differential settlement or movement resulting in cracking of the conduit
    b) Erosion of the seals or the conduit by cavitation immediately downstream of the gate
    c) Major seepage of water into the conduit
    d) Major deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
    e) Operation of the gate
    f) Corrosion of any metal
    g) Proper lubrication of the pedestal

**FIGURE 3.**

**GENERAL LAYOUT**

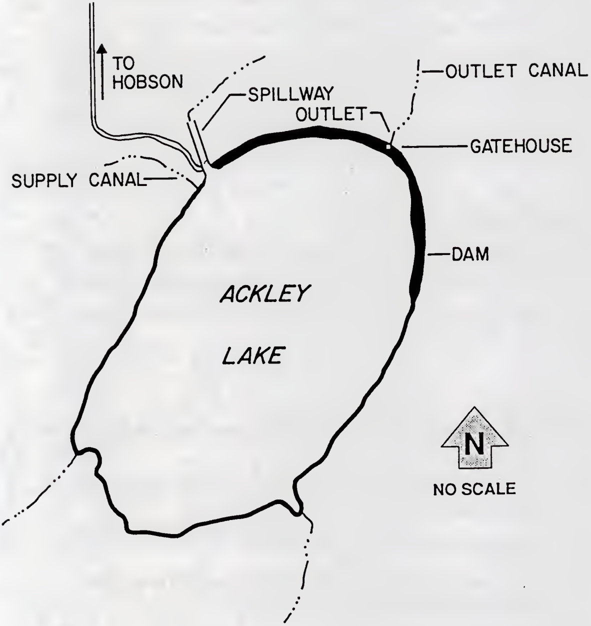


FIGURE 3. GENERAL LAYOUT

2. *Gatehouse* -- Any damage or vandalism

3. *Spillway*
    a) Erosion of the spillway channel

    b) Blockage of the approach or exit channel

## Riprap Inspection

The riprap along the face of the dam should measure at least 30 inches thick. Immediately after the occurrence of high water, the riprap should be inspected and additional riprap added if needed.

## Seepage Monitoring

Minor seepage at the toe of the embankment is marked by a willow area. The willows are cut and sprayed each year to allow closer observation of the seepage. A drain above the outlet discharges a nearly-constant flow of approximately 10 gallons per minute (gpm) which is measured annually by a SWPB inspector. Minor seepage flows into the outlet channel from a 6-inch drain on the left side of the outlet channel at a steady rate of about 2 gpm. Minor seepage has also been observed at the first two joints of the outlet pipe. All seepage sources are observed and monitored by the dam operator during regular visits and by the SWPB during annual inspections. To date, no seepage-measuring equipment has been installed at the dam.

## MAINTENANCE

The association is responsible for the project's routine maintenance. During regular visits, the dam operator will identify and perform normal maintenance activities. During the annual inspections, the SWPB will also identify items that need maintenance or repair. The SWPB may supervise major repairs.

### Routine Maintenance

As soon as a need is identified, the dam operator will perform any routine maintenance necessary to protect the dam or keep it in good working order. The dam operator will watch for any potential maintenance requirements during normal visits to the dam. Items that may occasionally need attention include, but are not limited to:

1. *Lubrication of gate-operating mechanisms.*
2. *Debris or silt restricting the spillway inlet or the outlet works.* Accumulated debris that could affect the operation of these appurtenances will be removed at once, with all debris removed at least annually.
3. *Erosion gullies on embankment.* Development of erosion gullies will be checked immediately. Gullies will be filled, compacted, and seeded. Particular attention will be paid to the abutment contact areas and the downstream face where four-wheel-drive or motorcycle tracks may become a problem.
4. *Rodent damage.* Rodent burrows will be filled immediately and the rodents destroyed.
5. *Upstream slope riprap.* Reservoir riprap normally will be maintained annually, but may occasionally need repairs because of high water or wave action.

6. *Vegetative cover on downstream slopes.* Good vegetative cover will be maintained, but large brush will be removed.

## Annual Maintenance

The SWPB will conduct annual inspections of Ackley Lake Dam and Reservoir. During these inspections, any items requiring maintenance will be identified and recorded. Items needing annual maintenance include the spillway, outlet works, gate, riprap, roads, and gatehouse. Any other routine items needing immediate attention will also be noted (such as removing trees and brush).

After the association receives the SWPB inspection report, it will develop a maintenance schedule for the identified items. While the dam operator or association members may perform these routine tasks, major repairs are more likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

## Record Keeping

The SWPB will maintain records—including photographs—of all inspections and maintenance requirements. These records will also include flow measurements and storage volumes. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in Helena.

The dam operator will keep records of the reservoir elevation, seepage observations or measurements, and any unusual conditions. These records may be reviewed at the dam operator's house.

## REFERENCES

Epkes, Roger, Ackley Lake dam operator. September 1993 - February 1994. Personal telephone and meeting communications with Marvin Cross, Havre Regional Office Civil Engineer Specialist, Water Resources Division, DNRC, Havre.

HKM Associates. May 1981. *Phase 1 Inspection Report, National Dam Safety Program, Ackley Lake Dam, Hobson, Montana, Judith Basin County Mt 10.* Prepared for the State of Montana (DNRC) under the U.S. Army Corps of Engineers National Dam Safety Program.

# APPENDIX A

# RATING CURVES AND TABLES

## TABLE A-1

## ACTIVE STORAGE
## ACKLEY LAKE RESERVOIR
MARCH 1965

| ELEV. | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,278 | 0 | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 |
| 4,279 | 70 | 77 | 84 | 91 | 98 | 105 | 112 | 119 | 126 | 133 |
| 4,280 | 140 | 147 | 154 | 161 | 168 | 175 | 182 | 189 | 196 | 203 |
| 4,281 | 210 | 217 | 224 | 231 | 238 | 245 | 252 | 259 | 266 | 273 |
| 4,282 | 280 | 287 | 294 | 301 | 308 | 315 | 322 | 329 | 336 | 343 |
| 4,283 | 350 | 361 | 372 | 382 | 393 | 404 | 415 | 426 | 436 | 447 |
| 4,284 | 458 | 469 | 480 | 491 | 502 | 513 | 523 | 534 | 545 | 556 |
| 4,285 | 567 | 578 | 589 | 600 | 611 | 622 | 632 | 643 | 654 | 665 |
| 4,286 | 676 | 687 | 698 | 708 | 719 | 730 | 741 | 752 | 762 | 773 |
| 4,287 | 784 | 795 | 806 | 817 | 828 | 839 | 849 | 860 | 871 | 882 |
| 4,288 | 893 | 904 | 915 | 925 | 936 | 947 | 958 | 969 | 979 | 990 |
| 4,289 | 1,001 | 1,012 | 1,023 | 1,034 | 1,045 | 1,056 | 1,066 | 1,077 | 1,088 | 1,099 |
| 4,290 | 1,110 | 1,121 | 1,132 | 1,142 | 1,153 | 1,164 | 1,175 | 1,186 | 1,196 | 1,207 |
| 4,291 | 1,218 | 1,229 | 1,240 | 1,251 | 1,262 | 1,273 | 1,283 | 1,294 | 1,305 | 1,316 |
| 4,292 | 1,327 | 1,338 | 1,349 | 1,359 | 1,370 | 1,381 | 1,392 | 1,403 | 1,413 | 1,424 |
| 4,293 | 1,435 | 1,450 | 1,465 | 1,479 | 1,494 | 1,509 | 1,524 | 1,539 | 1,553 | 1,568 |
| 4,294 | 1,583 | 1,598 | 1,613 | 1,627 | 1,642 | 1,657 | 1,672 | 1,687 | 1,701 | 1,716 |
| 4,295 | 1,731 | 1,746 | 1,761 | 1,775 | 1,790 | 1,805 | 1,820 | 1,835 | 1,849 | 1,864 |
| 4,296 | 1,879 | 1,894 | 1,909 | 1,923 | 1,938 | 1,953 | 1,968 | 1,983 | 1,997 | 2,012 |
| 4,297 | 2,027 | 2,042 | 2,057 | 2,071 | 2,086 | 2,101 | 2,116 | 2,131 | 2,145 | 2,160 |
| 4,298 | 2,175 | 2,192 | 2,208 | 2,225 | 2,241 | 2,258 | 2,274 | 2,291 | 2,307 | 2,324 |
| 4,299 | 2,340 | 2,357 | 2,373 | 2,390 | 2,406 | 2,423 | 2,439 | 2,456 | 2,472 | 2,489 |
| 4,300 | 2,505 | 2,522 | 2,538 | 2,555 | 2,571 | 2,588 | 2,604 | 2,621 | 2,637 | 2,654 |
| 4,301 | 2,670 | 2,687 | 2,703 | 2,720 | 2,736 | 2,753 | 2,769 | 2,786 | 2,802 | 2,819 |
| 4,302 | 2,835 | 2,852 | 2,868 | 2,885 | 2,901 | 2,918 | 2,934 | 2,951 | 2,967 | 2,984 |
| 4,303 | 3,000 | 3,021 | 3,041 | 3,062 | 3,083 | 3,104 | 3,124 | 3,145 | 3,166 | 3,186 |
| 4,304 | 3,207 | 3,228 | 3,248 | 3,269 | 3,290 | 3,311 | 3,331 | 3,352 | 3,373 | 3,393 |
| 4,305 | 3,414 | 3,435 | 3,455 | 3,476 | 3,497 | 3,518 | 3,538 | 3,559 | 3,580 | 3,600 |
| 4,306 | 3,621 | 3,642 | 3,662 | 3,683 | 3,704 | 3,725 | 3,745 | 3,766 | 3,787 | 3,807 |
| 4,307 | 3,828 | 3,849 | 3,869 | 3,890 | 3,911 | 3,932 | 3,952 | 3,973 | 3,994 | 4,014 |
| 4,308 | 4,035 | 4,057 | 4,080 | 4,102 | 4,124 | 4,147 | 4,169 | 4,191 | 4,213 | 4,236 |
| 4,309 | 4,258 | 4,280 | 4,303 | 4,325 | 4,347 | 4,370 | 4,392 | 4,414 | 4,436 | 4,459 |
| 4,310 | 4,481 | 4,503 | 4,526 | 4,548 | 4,570 | 4,593 | 4,615 | 4,637 | 4,659 | 4,682 |
| 4,311 | 4,704 | 4,726 | 4,749 | 4,771 | 4,793 | 4,816 | 4,838 | 4,860 | 4,882 | 4,905 |
| 4,312 | 4,927 | 4,949 | 4,972 | 4,994 | 5,016 | 5,039 | 5,061 | 5,083 | 5,105 | 5,128 |
| 4,313 | 5,150 | 5,175 | 5,200 | 5,225 | 5,250 | 5,275 | 5,299 | 5,324 | 5,349 | 5,374 |
| 4,314 | 5,399 | 5,424 | 5,449 | 5,474 | 5,499 | 5,524 | 5,548 | 5,573 | 5,598 | 5,623 |
| 4,315 | 5,648 | 5,673 | 5,698 | 5,723 | 5,748 | 5,773 | 5,797 | 5,822 | 5,847 | 5,872 |

Add 325 acre-feet for total storage.
Design spillway crest elevation is 4,315.67 and storage is 5,815 acre-feet.
Grillage elevation in gatehouse is 4,323.00.

## TABLE A-2

### ACKLEY LAKE
### SLOPE DISTANCE TABLE

| Slope Distance | Elevation *(Feet)* | Contents *(Acre-feet)* | Slope Distance | Elevation *(Feet)* | Contents *(Acre-feet)* |
|---|---|---|---|---|---|
| 0+00 | 4321.76 | 7,434 | +33 | 4308.59 | 4,167 |
| +01 | 21.51 | 7,365 | +34 | 08.15 | 4,069 |
| +02 | 21.02 | 7,231 | +35 | 07.69 | 3,971 |
| +03 | 20.77 | 7,162 | +36 | 07.47 | 3,926 |
| +04 | 20.41 | 7,063 | +37 | 07.23 | 3,875 |
| +05 | 20.12 | 6,983 | +38 | 06.74 | 3,774 |
| +06 | 19.40 | 6,785 | +39 | 06.57 | 3,739 |
| +07 | 19.05 | 6,689 | 0+40 | 06.29 | 3,681 |
| +08 | 19.00 | 6,675 | +41 | 06.00 | 3,621 |
| +09 | 18.00 | 6,400 | +42 | 05.68 | 3,555 |
| 0+10 | 17.54 | 6,285 | +43 | 05.57 | 3,532 |
| +11 | 17.06 | 6,165 | +44 | 05.38 | 3,493 |
| +12 | 17.06 | 6,165 | +45 | 05.17 | 3,449 |
| +13 | 16.91 | 6,127 | +46 | 04.95 | 3,404 |
| +14 | 16.40 | 5,999 | +47 | 04.82 | 3,377 |
| +15 | 15.79 | 5,846 | +48 | 04.78 | 3,369 |
| +16 | 15.76 | 5,839 | +49 | 04.65 | 3,342 |
| +17 | 15.71 | 5,826 | 0+50 | 04.53 | 3,317 |
| +17.1 | 15.67 | 5,815 | +51 | 04.23 | 3,254 |
| +18 | 15.21 | 5,701 | +52 | 03.73 | 3,151 |
| +19 | 14.79 | 5,596 | +53 | 03.54 | 3,112 |
| 0+20 | 14.43 | 5,506 | +54 | 03.43 | 3,089 |
| +21 | 14.43 | 5,506 | +55 | 03.34 | 3,070 |
| +22 | 14.20 | 5,449 | +56 | 03.19 | 3,039 |
| +23 | 13.72 | 5,329 | +57 | 03.08 | 3,017 |
| +24 | 12.33 | 5,001 | +58 | 02.95 | 2,992 |
| +25 | 12.14 | 4,958 | +59 | 02.82 | 2,970 |
| +26 | 11.60 | 4,838 | 0+60 | 02.68 | 2,948 |
| +27 | 10.86 | 4,673 | +61 | 02.55 | 2,926 |
| +28 | 10.46 | 4,584 | +62 | 02.47 | 2,913 |
| +29 | 10.05 | 4,492 | +63 | 02.27 | 2,880 |
| 0+30 | 09.98 | 4,477 | +64 | 02.17 | 2,863 |
| +31 | 09.54 | 4,379 | +65 | 01.94 | 2,825 |
| +32 | 08.86 | 4,227 | +66 | 01.83 | 2,807 |

## **TABLE A-2** *continued*

| **Slope Distance** | **Elevation** *(Feet)* | **Contents** *(Acre-feet)* | **Slope Distance** | **Elevation** *(Feet)* | **Contents** *(Acre-feet)* |
|---|---|---|---|---|---|
| +67 | 4301.69 | 2,784 | +01 | 4298.32 | 2,228 |
| +68 | 01.53 | 2,758 | +02 | 98.09 | 2,190 |
| +69 | 01.41 | 2,738 | +03 | 97.84 | 2,151 |
| 0+70 | 01.30 | 2,720 | +04 | 97.65 | 2,124 |
| +71 | 01.18 | 2,700 | +05 | 97.48 | 2,098 |
| +72 | 01.12 | 2,690 | +06 | 97.29 | 2,070 |
| +73 | 00.01 | 2,672 | +07 | 97.21 | 2,058 |
| +74 | 00.82 | 2,640 | +08 | 97.17 | 2,053 |
| +75 | 00.72 | 2,624 | +09 | 96.96 | 2,021 |
| +76 | 00.58 | 2,601 | 1+10 | 96.70 | 1,983 |
| +77 | 00.47 | 2,583 | +11 | 96.50 | 1,953 |
| +78 | 00.44 | 2,578 | +12 | 96.34 | 1,929 |
| +79 | 00.40 | 2,571 | +13 | 96.25 | 1,916 |
| 0+80 | 00.35 | 2,563 | +14 | 96.19 | 1,908 |
| +81 | 00.27 | 2,550 | +15 | 96.11 | 1,896 |
| +82 | 00.23 | 2,543 | +16 | 96.03 | 1,884 |
| +83 | 00.16 | 2,532 | +17 | 95.98 | 1,876 |
| +84 | 4300.06 | 2,515 | +18 | 95.89 | 1,863 |
| +85 | 4299.93 | 2,494 | +19 | 95.85 | 1,857 |
| +86 | 99.77 | 2,467 | 1+20 | 95.79 | 1,848 |
| +87 | 99.62 | 2,442 | +21 | 95.68 | 1,832 |
| +88 | 99.44 | 2,413 | +22 | 95.64 | 1,826 |
| +89 | 99.34 | 2,396 | +23 | 95.55 | 1,813 |
| 0+90 | 99.17 | 2,368 | +24 | 95.41 | 1,792 |
| +91 | 99.09 | 2,355 | +25 | 95.26 | 1,769 |
| +92 | 98.92 | 2,327 | +26 | 95.12 | 1,749 |
| +93 | 98.80 | 2,307 | +27 | 94.85 | 1,709 |
| +94 | 98.72 | 2,294 | +28 | 94.64 | 1,678 |
| +95 | 98.70 | 2,291 | +29 | 94.43 | 1,647 |
| +96 | 98.64 | 2,281 | 1+30 | 94.25 | 1,620 |
| +97 | 98.60 | 2,274 | +31 | 94.12 | 1,601 |
| +98 | 98.56 | 2,266 | +32 | 93.99 | 1,582 |
| +99 | 98.56 | 2,266 | +33 | 93.99 | 1,582 |
| 1+00 | 98.51 | 2,260 | +34 | 93.95 | 1,576 |

## TABLE A-2 *continued*

| **Slope Distance** | **Elevation** *(Feet)* | **Contents** *(Acre-feet)* | **Slope Distance** | **Elevation** *(Feet)* | **Contents** *(Acre-feet)* |
|---|---|---|---|---|---|
| +35 | 4293.95 | 1,576 | +49 | 4290.85 | 1,202 |
| +36 | 93.90 | 1,568 | 1+50 | 90.23 | 1,135 |
| +37 | 93.81 | 1,555 | +51 | 90.96 | 1,106 |
| +38 | 93.64 | 1,530 | +52 | 89.42 | 1,047 |
| +39 | 93.35 | 1,487 | +53 | 89.14 | 1,016 |
| 1+40 | 93.02 | 1,438 | +54 | 88.44 | 940 |
| +41 | 92.52 | 1,383 | +55 | 88.22 | 917 |
| +42 | 92.16 | 1,345 | +56 | 88.02 | 895 |
| +43 | 92.87 | 1,313 | +57 | 87.99 | 892 |
| +44 | 91.64 | 1,287 | +58 | 87.49 | 838 |
| +45 | 91.30 | 1,251 | +59 | 86.68 | 750 |
| +46 | 91.11 | 1,230 | | | |
| +47 | 91.01 | 1,219 | | | |
| +48 | 90.97 | 1,215 | | | |

This table is for active storage. To get total storage, add 325 acre-feet of dead storage.

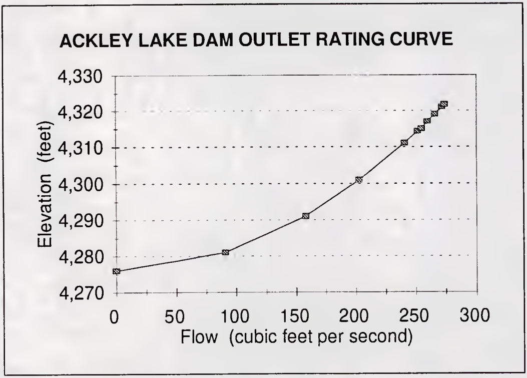
January 13, 1995 - corrected elevation data.

## TABLE A-3

## ACKLEY LAKE DAM
## OUTLET RATING TABLE

| **Elevation** *(feet)* | **Flow** *(cfs)* |
|---|---|
| 4,278.0 | 0 |
| 4,283.0 | 91 |
| 4,293.0 | 158 |
| 4,303.0 | 203 |
| 4,313.0 | 241 |
| 4,316.3 | 252 |
| 4,317.0 | 255 |
| 4,319.0 | 260 |
| 4,321.0 | 266 |
| 4,323.0 | 272 |
| 4,323.7 | 275 |

**FIGURE A-1**

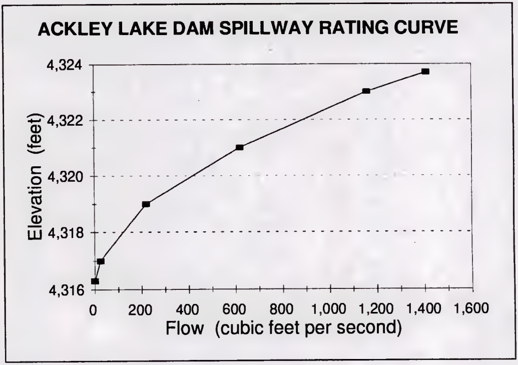


## TABLE A-4

### SPILLWAY RATING TABLE

| Elevation (feet) | Flow (cfs) |
|---|---|
| 4,316.3 | 0 |
| 4,317.0 | 25 |
| 4,319.0 | 220 |
| 4,321.0 | 620 |
| 4,323.0 | 1,160 |
| 4,323.7 | 1,410 |

## FIGURE A-2



# APPENDIX B

# INSPECTION CHECKLIST

## DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
## DAM SAFETY INSPECTION REPORT

NAME OF DAM ____________________
DATE INSPECTED ____________________

INVENTORY NO. ________________
HAZARD CATEGORY ________________
TYPE OF DAM ________________
YEAR BUILT ________________

OWNER ________________
OPERATOR ________________
STREAM ________________
DRAINAGE AREA ____________

Reservoir Storage Status

| | Water Surface Elevation (feet) | Storage (acre-feet) |
|---|---|---|
| At time of inspection | ________ | ________ |
| At spillway crest | ________ | ________ |
| At min. dam crest elevation | ________ | ________ |
| Flashboard crest elevation | ________ | ________ |

| ITEM | YES | NO | REMARKS | *ICC |
|---|---|---|---|---|

1. **EMBANKMENT**

A. Crest -- Height= Length= Width=

| | | | | |
|---|---|---|---|---|
| (1) Any visual settlements? | | | | 3 |
| (2) Any misalignments? | | | | 4 |
| (3) Any cracking? | | | | 1 |
| (4) Any traffic damage? | | | | 5 |
| (5) Other? | | | | 7 |

NOTE: *ICC stands for "Inventory Comment Code" which is found on the Inventory of Montana Dams. This comment code is for use by the Dam Safety Section.

| ITEM | YES | NO | REMARKS | *ICC |
|---|---|---|---|---|

1. EMBANKMENT (continued)

B. Upstream Face -- Slope=

| | | | | |
|---|---|---|---|---|
| (1) Any erosion? | | | | 13 |
| (2) Any longitudinal cracks? | | | | 9 |
| (3) Any transverse cracks? | | | | 9 |
| (4) Is riprap protection adequate? | | | | 10 |
| (5) Any stone deterioration? | | | | 10 |
| (6) Any visual settlement, slumps, sloughing, depressions or bulges? | | | | 9 |
| (7) Adequate grass cover? | | | | 14 |
| (8) Debris on the dam face? | | | | 15 |
| (9) Other? | | | | 16 |

C. Downstream Face--Slope=

| | | | | |
|---|---|---|---|---|
| (1) Any erosion? | | | | 22 |
| (2) Any longitudinal cracks? | | | | 19 |
| (3) Any transverse cracks? | | | | 19 |
| (4) Any visual settlement, sloughing, slumps, depressions or bulges? | | | | 19 |
| (5) Is the toe drain dry? | | | | 31 |
| (6) Are the relief wells flowing? | | | | 31 |
| (7) Any boils at the toe? | | | | 19 |
| (8) Any seepage areas? | | | | 17, 18 |
| (9) Any traffic or animal damage? | | | | 22 |
| (10) Any burrowing animals? | | | | 21 |
| (11) Adequate grass cover? | | | | 24 |
| (12) Other? | | | | 25 |

D. Amount and Type of Vegetation on the Dam

| | |
|---|---|
| | 14, 24 |

| ITEM | YES | NO | REMARKS | *ICC |
|---|---|---|---|---|

## 2. ABUTMENT CONTACTS

| | | | | |
|---|---|---|---|---|
| (A) Any erosion? | | | | 12, 20 |
| (B) Any visual differential movement? | | | | 12, 20 |
| (C) Any cracks? | | | | 12, 20 |
| (D) Any seepage present? | | | | 36 |
| (E) Other? | | | | 16, 25 |

## 3. OUTLET WORKS

A. Intake Structure -- Size=

| | | | | |
|---|---|---|---|---|
| (1) Any settlement? | | | | 70 |
| (2) Any tilting? | | | | 70 |
| (3) Do concrete surfaces show: | | | | |
| a. Spalling? | | | | 70 |
| b. Cracking? | | | | 70 |
| c. Erosion? | | | | 70 |
| d. Exposed reinforcement? | | | | 70 |
| (4) Do joints show: | | | | |
| a. Displacement or offset? | | | | 70 |
| b. Loss of joint material? | | | | 70 |
| c. Leakage? | | | | 70 |
| (5) Metal appurtenances: | | | | |
| a. Any corrosion present? | | | | 70 |
| b. Any breakage present? | | | | 71 |
| (6) Trash rack? | | | | 71 |
| a. Condition? | | | | 71 |
| b. Anchor system secure? | | | | 71 |
| (7) Other? | | | | 71 |

| ITEM | YES | NO | REMARKS | *ICC |
|---|---|---|---|---|

3. OUTLET WORKS (continued)

B. Conduit -- Type = Size =

| | | | | |
|---|---|---|---|---|
| (1) Do concrete surfaces show: | | | | |
| a. Spalling? | | | | 76 |
| b. Cracking? | | | | 76 |
| c. Erosion? | | | | 76 |
| d. Exposed reinforcement? | | | | 76 |
| (2) Do joints show: | | | | |
| a. Displacement or offset? | | | | 76 |
| b. Loss of joint material? | | | | 75 |
| c. Leakage? | | | | 76 |
| (3) Is the conduit metal? | | | | 76 |
| a. Any corrosion present? | | | | 76 |
| b. Protective coatings adequate? | | | | 76 |
| (4) Is the conduit misaligned? | | | | 76 |
| (5) Any calcium deposits? | | | | 76 |
| (6) Other? | | | | 76 |

C. Gates and Tower

| | | | | |
|---|---|---|---|---|
| (1) Gates: | | | | 73, 74 |
| a. Size: Operating: Emergency:<br>b. Type: Operating: Emergency: | | | | |
| (2) Controls operational? | | | | 75 |
| (3) Controls lubricated? | | | | 75 |
| (4) Operational problems? | | | | 75 |
| (5) Leakage around gates? | | | | 73, 74 |
| (6) Condition of gate seals? | | | | 73, 74 |
| (7) Any cavitation damage? If so, describe? | | | | 73, 74 |
| (8) Describe air vent-size and condition. | | | | 73, 74 |

| ITEM | YES | NO | REMARKS | *ICC |
|---|---|---|---|---|

## 3. OUTLET WORKS

### C. Gates and Tower (continued)

| | | | | |
|---|---|---|---|---|
| (9) Is there a jet pump? | | | | 62 |
| a. Is it operational? | | | | 62 |
| b. Leakage? | | | | 62 |
| (10) Is the tower dry? ____ wet? ____ | | | | 77 |
| (11) Any seepage in the tower? | | | | 77 |
| (12) Condition of the tower? | | | | 77 |
| (13) Any safety problems? | | | | 77 |
| (14) Ladder in good condition? | | | | 77 |
| (15) Condition of the gate house? | | | | 81 |
| (16) Emergency plan completed for the dam? | | | | 43 |
| a. Posted in the gatehouse? | | | | 43 |
| (17) Other? | | | | 82 |

### D. Stilling Basin

| | | | | |
|---|---|---|---|---|
| (1) Do concrete surfaces show: | | | | |
| a. Spalling? | | | | 62 |
| b. Cracking? | | | | 62 |
| c. Erosion? | | | | 62 |
| d. Exposed reinforcement? | | | | 62 |
| (2) Do joints show: | | | | |
| a. Displacement or offset? | | | | 62 |
| b. Loss of joint material? | | | | 62 |
| c. Leakage? | | | | 62 |
| (3) Do energy dissipators show: | | | | |
| a. Signs of deterioration? | | | | 62 |
| b. Are they covered with debris? | | | | 62 |
| (4) Other? | | | | 63 |

| ITEM | YES | NO | REMARKS | *ICC |
|---|---|---|---|---|

3. OUTLET WORKS (continued)

E. Downstream Channel

| | | | | |
|---|---|---|---|---|
| (1) Is the channel: | | | | |
| a. Eroding or backcutting? | | | | 38 |
| b. Sloughing? | | | | 38 |
| c. Obstructed? | | | | 40 |
| (2) Is released water: | | | | |
| a. Undercutting the outlet? | | | | 52, 62 |
| b. Eroding the embankment? | | | | 52, 62 |
| (3) Other? | | | | 56,63 |

4. **SPILLWAY**

A. Description

| | | | | |
|---|---|---|---|---|
| (1) Location? | | | | N/A |
| (2) Type of Spillway? | | | | N/A |
| (3) Size of Spillway? | | | | N/A |
| (4) Spillway lining? | | | | N/A |
| (5) Is there a weir? | | | | 61 |
| (6) Is the spillway in good condition? | | | | N/A |
| (7) Any drains? | | | | N/A |
| a. Describe the condition of drains. | | | | 64 |

B. Does spillway show:

| | | | | |
|---|---|---|---|---|
| (1) Any cracking concrete? | | | | 57, 58 |
| (2) Any spalling concrete? | | | | 57, 58 |
| (3) Any exposed reinforcement in the concrete? | | | | 57, 58 |
| (4) Any erosion? | | | | 52 |

| ITEM | YES | NO | REMARKS | *ICC |
|---|---|---|---|---|

4. B. Does spillway show: (continued)

| | | | | |
|---|---|---|---|---|
| (5) Any slope sloughing? | | | | 51 |
| (6) Any obstructions? | | | | 54 |
| (7) Displacement or offset joints? | | | | 59 |
| (8) Loss of joint material? | | | | 57, 58 |
| (9) Leakage at the joints? | | | | 57, 58 |
| (10) Other? | | | | 63 |

C. Do the energy dissipators show:

| | | | | |
|---|---|---|---|---|
| (1) Signs of deterioration? | | | | 62 |
| (2) Any cracking? | | | | 62 |
| (3) Any spalling? | | | | 62 |
| (4) Any exposed reinforcement? | | | | 62 |
| (5) Are they covered with debris? | | | | 62 |
| (6) Other? | | | | 64 |

D. Has release water:

| | | | | |
|---|---|---|---|---|
| (1) Eroded the embankment? | | | | 52 |
| (2) Undercut the outlet? | | | | 52 |
| (3) Eroded the downstream channel? | | | | 52 |
| (4) Other? | | | | 56 |

E. Emergency Spillway

| | | | | |
|---|---|---|---|---|
| (1) Is there an emergency spillway? | | | (If YES, describe) | 55 |
| | | | | |

| ITEM | YES | NO | REMARKS | *ICC |
|---|---|---|---|---|

## 5. RESERVOIR CONTROL

| | | | | |
|---|---|---|---|---|
| (A) Recent upstream development? | | | | 47 |
| (B) Recent downstream development? | | | | 42 |
| (C) Slides in reservoir area? | | | | 44 |
| (D) Change in reservoir operation? | | | | 42 |
| (E) Large impoundment upstream? | | | | 49 |
| (F) Any debris in the reservoir? | | | | 50 |
| (G) Other? | | | | 50 |

## 6. INSTRUMENTATION

| | | | | |
|---|---|---|---|---|
| (A) List type(s) of instrumentation: | | | | 27-33 |
| (B) In good condition? | | | | 27-33 |
| (C) Read periodically? | | | | 27-33 |
| (D) Is data available? | | | | 27-33 |
| (E) Include all data gathered since last report. | | | | |

## 7. DOWNSTREAM CONDITION

A. Downstream Land Use.

| | |
|---|---|
| | 41 |

This dam was inspected by:

Additional comments and recommendations. (Use additional pages)